Neutrino Reactions in Nuclei and the Neutron Number

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- We compare the inclusive electron neutrino cross sections,

$$\nu_e + N_i \longrightarrow X + e^-$$

averaged over the Michel spectrum for the nuclei $^{12}C,^{13}C,^{56}Fe$ and ^{127}I. We shall use ^{56}Fe as a model and present recent results for neutrino and antineutrino reactions in this nucleus. We shall make use of a structure function model to obtain the hadronic part of of the transition matrix element which is given by:

$$M_{ki} = \frac{G}{\sqrt{2}} \cos\theta_c \bar{u}_e \gamma^\lambda (1-\gamma_5) < k|J_\lambda(0)|^{56}Fe >$$

for the whole transition. Here k is a particular final state and the matrix element squared is summed over k. The result which we obtain for the electron neutrino reaction averaged over the Michel spectrum will be shown to be for ^{56}Fe:

$$< \sigma > = 214 \ \pm \ 25\% \ \times \ 10^{-42} \ cm^2$$

in good agreement with other theoretical calculations and with the present experimental data[1] which does however have large uncertainties.

It will be shown that the electron neutrino cross sections averaged over the Michel neutrino spectrum for the four nuclei given above lie along a line given by:

$$< \sigma > = [9.11(A-Z) - 37.23] \ \times \ 10^{-42} \ cm^2$$

where $A-Z$ is the neutron number of the nucleus. We shall discuss possible reasons for a limitations of this result. We shall also present some new results for the stable isotopes of lead and show how they fall on this line.

References

[1]R. Maschuw, Prog. Part. Nucl. Phys. **40** (1998)183.